Tetrao viridis, Gm. S. N. i. p. 761. no. 46, ♀ (1788), ex Lath.

Perdix coronata, Lath. Suppl. Ind. Orn. p. 62. no. 1, ♂ et ♀ (1801).

Cryptonyx coronatus, Temm. Pl. Col. 350, ♂, 351, ♀, "Malacca, Sumatra, rare in Java (?)."

"Marup, ♂, iris brown, bill (red at base) black, legs coral-red."

Examples of both sexes, undistinguishable from Malaccan individuals.

Rhizothera longirostra (Temm.), Pig. & Gallin. iii. pp. 323, 721, "Sumatra" (1815); Gray & Hardw. Ill. Ind. Zool. pl. —. fig. 2, ♀.

Tetrao curvirostris, Raffles, Tr. Linn. Soc. xiii. p. 323, "Sumatra" (1821).

"Busan, October, ♂, ♀, iris sienna red, bill black, legs white; Marup, July, ♀, iris brick-red, legs whitish."

These three examples agree perfectly with as many Malaccan specimens collected by the late Mr. Maingay. That gentleman noted one of his grey-breasted specimens as being a male. The example marked male by Mr. Everett has also a grey breast; and the two marked as being females are without the cinereous pectoral band. These independent observations coincide with Temminck's statements (*l. c.*).

Hypotænidia striata (Linn.), S. N. i. p. 262, "Philippines" (1766), ex Brisson; Walden, Tr. Zool. Soc. viii. p. 95.

"Marup, ♂, iris purple-red, legs leaden, bill red-brown."

In perfect plumage. Identical with Malaccan examples.

XLIII.—*On the Motmots and their Affinities.*

By Dr. James Murie, F.L.S. &c.

(Plates XIII.–XV.)

"If naturalists, before offering an opinion on the affinities of groups, were but to consider well the totality of characters belonging to each of those which they suspect to be allied, were but to study all their points of difference as eagerly as they catch at those of similarity, the progress of scientific ornithology would be greatly accelerated" *. If Mr. Blyth's contributions to natural history had been limited even to this single sentence, irrespective of his vast additions to its literature for the last forty years, he would still be entitled to the acknowledgments of ornithologists; for his words are pregnant of much that yet remains to be done ere the gleaners leave the field.

In the obituary of the last Number of 'The Ibis' † Mr. George Gray's worthy life's labours are commented on; but the writer, *en passant*, gently touches on a peculiarity of the deceased most uncommon in these days, "conciseness to a fault—the problem and answer without the intermediate operations," &c.

The above allusions to two experienced toilers in ornithology, practically suggest the course to be pursued in the present investigation, viz. a review of the osteological organization of the Momotidæ in its completeness, with unbiased comparisons, thus affording the data and their legitimate deductions. The ugly barrier to some generalizations concerning groups is the scarcity of dubious or transitionary forms. Hence the halting gait of bird-lore in its anatomical phase, and hence the greater necessity for trustworthy descriptive notices of single specimens or as many of a sort as can be got together. My present subjects, osteologically, are far more ample than those dealt with by previous writers; yet neither the bones of every species, nor of all the genera, have I been able to lay hands on. That which I bring forward, however, enables recognition of affinities to be traced.

I. *The Skull and Sternum of* MOMOTUS LESSONI.

Dealing with my material as it has come to hand, I may note that the cranium of this species measures 2·6 inches long. If this be divided into three segments, the anterior premaxillary comprises 1·5, the orbital 0·6, and the posterior brain-division 0·5 inch.

From above the outline is long and conical, the lateral edges of the beak, however, being just perceptibly concave. The orbital emarginations are clean crescent-shaped sweeps, the posterior limb, mayhap, being a trifle the longer. The interorbital

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* Mag. of Nat. Hist. 1838, vol. ii. p. 318.

† Pp. 340–342.

segment is low and depressed, the middle premaxillary rods, without great elevation, meeting the former at the transverse cranio-facial hinge. Nostrils moderate-sized, situated well back, but with a broadish portion of nasal bone behind.

In the posterior or occipital face the postfrontal processes (*Pf.* fig 5) outflank the part behind, and descend, with slight obliquity, outwards. The superior median parietal groove is shallow, the temporal much better marked, leaving a narrow deepish interspace betwixt the postfrontal and zygomatic processes. The occipital bones are altogether flattish and low.

The inferior base of the skull agrees in contour with the view from the top. The orbital vacuity, here bounded by the jugal, pterygoid, and palatal plate, is long and moderately wide. The pterygoids are situate far back. Basitemporal area decidedly short, though widish, and the foramen magnum comes into full view.

In profile, from the point of the beak to the eye is longer than from the lachrymal to the occiput. There is a gentle steady curve from tip to root of the præmaxilla, without it being vertically deep at any point. Orbit relatively large. The forehead at first rises a little abruptly, and is nearly at full height midorbitally. The postfrontal and zygomatic (*z*, fig. 6) processes and the lachrymal do not encroach much into the orbit. The occipital surface presents a wide and open angle perpendicularly.

In examination of the bones individually, there is noticeable a linear shallow elliptical groove, fully half an inch long at the anterior apex of the palate; this is continued as a single median sulcus backwards to the maxillo-palatines. The palatal surface of the præmaxillæ, transversely and longitudinally, shows a shallow concavity; and the maxillary depressions are acutely angular. Maxillo-palatines spongy, large, and meet each other in the middle line without absolute confluence. Their posterior transverse margins are abruptly truncate. The horizontal palatal plates cease forwards 0·3 inch on the maxillo-palatines. Each is narrower than the space which separates them. Forwardly they are flat, but rearwards slope inwards, leaving a lyre-shaped interval 0·2 inch at widest. The postpalatine plates are slightly scooped; their outer borders shear in behind curvilinearly and without posterior external palatine spicules; their approximating edges are flanged. The palate-bones are continued half an inch behind the maxillo-palatines, and are thus relatively long.

Correspondingly the pterygoid bars are short, set widely apart from each other, and leave but narrow clefts between them and the basitemporal. Anteriorly the pterygoid joins the rostrum and palatal plate by an upwardly bent hinge, fitting partially against the rostrum of the basisphenoid. The pterygoid rods, though flat and tolerably straight, have a considerable twist on their long axis. Jugals long and slender.

The upper premaxillary surface presents moderate arching and barely a culmen. There is a true beak-hinge transversely cutting the nasals, maxillaries, and naso-premaxillary rods from the prefrontals and lachrymals. The nostrils, each half an inch long, are of a wide oval figure. Nasal septum partially ossified. No definition exists between maxillaries and nasals. It would seem, on ordinary examination, as if the lachrymals were absent or lost in the specimen. But I have satisfied myself that they exist in a very rudimentary condition, being merely anchylosed ossicles to the prefrontal processes (*f p*, fig. 6.). In the dried skull, therefore, the fissure (*f*) which separates the beak from the præethmoid is open, and not, as usual, partially hidden by the tear-bones. The same condition of things nearly obtains in some of the Bee-eaters, a membrane occupying the place of or strengthening the delicate spicule or well-nigh absent inferior lachrymal limb on each side. There is very marked pitting of the nasal and frontal superficies. The interorbital portion of the frontal is broad, and the triangular prefrontal processes strike well outwards and downwards. Postfrontal and zygomatic processes are subequal in length, but neither reaches the jugal. Temporal groove short, but well impressed. The basioccipitals and basitemporal are not very uneven. Eustachian cavity large, rostrum of basisphenoid short.

Interorbital septum well nigh closed by an ossific plate. There is an orbito-sphenoid ridge. Orbital limb of the quadrate largish, but the bone altogether only moderately high. Inferior knuckles two in number, set at right angles to each other.

The sternum is short and broad, with two pairs of oval perforations. In the specimen examined by me the innermost on the left side was reduced to a couple of small foramina. Pectoral plates flattish, and, so far as can be judged, inclining to a chevron-shape. Keel deep forwards, and well produced in a ploughshare, with shallow middle emarginations. Costal process strong, long, and with four costal facets. Rostrum acuminate, length moderately upturned and interiorly excavated.

Coracoid 1·05 inch, the oblique sternal diameter 0·8 inch, scapula 1·2 inch, and furcula 0·9 inch long.

The furcula has no descending process or interclavicle. It has a wide inferior arch, where the bones are very slender; superiorly they are stouter, but have no special expansion. Shaft of coracoid flat, and epicoracoid extension moderate; the head of the shaft presents little enlargement; acromion absent. Scapula pretty straight, or with only a light curve to the broadish terminal end.

II. *Cranium &c. of* MOMOTUS BRASILIENSIS.

This species I have not had an opportunity of examining; but Mr. Eyton [*] makes a few remarks upon it, which I need not quote, as they agree well with what has been said of *M. lessoni.* He observes, the head presents some likeness to that of *Coracias garrula.* His outline of the postpalatals of *M. brasiliensis* [†] appears a perfect counterpart of the same region of *M.* (*Baryphthengus*) *ruficapillus,* a diminutive rod-like vomer being represented.

Of measurements, he gives head 2·8 inch long, breadth 1·2, humerus 1·6, ulna 1·7, metacarpus 0·7, tibia 1·8, and metatarsus in length 1·2. Save ulna, these closely correspond with the measurement of *M.* (*B.*) *ruficapillus.*

III. *Osteology of* MOMOTUS (BARYPHTHENGUS) RUFICAPILLUS.

Levaillant [‡] figured a species of Motmot under the name of "Le Motmot dombé," to which Vieillot [§] gave the name of

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[*] Osteologia Avium, p. 59.

[†] Pl. xii. fig. 12.

[‡] Ois. de Par. i. p. 113, pl. 39.

[§] Nouv. Dict. d'Hist. Nat. t. xxi. p. 258.

Baryphonus ruficapillus, and others the names *levaillantii, dombeyeanus, dombeyi, tutu,* and *rubricapillus.* Dr. Sclater[*] at one time held that the *Motmot dombé* was doubtfully referable to *Momotus cyanogaster,* founded by Vieillot on the "Tutu" of Azara; but at a later date[†] he followed Dr. Cabanis[‡] in calling the bird *Baryphthengus ruficapillus.*

I mention this circumstance because of my having received, through the kindness of Mr. O. Salvin, a skeleton labelled by him as belonging to *Momotus* (*Baryphthengus*) *ruficapillus,* from Rio Janeiro, the name of which is therefore authenticated by the last-mentioned ornithologist. I shall institute a comparison of this reputed genus with those treated of in the last sections and *Eumomota,* to see if the bones bear out the differential value assigned to it by slight variation in the feathering, viz. 10 rectrices, the middle non-spatulate.

The vertebræ, taken regionally, are:—cervical 13; dorsal 6; lumbo-sacral 11 or 12; caudal 7; equivalent to a total of 37 or 38.

There are 7 ribs on either side, the hindmost pair being truly lumbar ones. Besides these well-developed costæ I also observed a pair of rudimentary ribs (or riblets) in connexion with the last neck-vertebræ. Spinal column and ribs appear in numbers, &c., to resemble those of *Eumomota.*

To compensate for having only figured a portion of the base of the skull (Pl. XV. fig. 44) I may note a few of its admeasurements. Extreme length 2·8; greatest width at the quadrates 1·2; greatest vertical depth without the mandible 1·0; transverse diameter at the base of the beak 0·75; transverse diameter immediately in front of the nares 0·4; and the mandible in extreme length 2·5 inches. The cranium, therefore, is longer than that of *Momotus lessoni* by about 0·2 inch, other measurements yielding increment in proportion.

The cranial configuration agrees with the latter in nearly every respect, the only variation consisting in a trifle more arching of the beak and narrowing forwards, a kind of ploughshare-like expansion of the orbital limb of the quadrate, and possession of a diminutive rod-like vomer—points which are, I should say, of no more than specific value, the last possibly but evidence of the greater intactness of the specimen after maceration; for, as I have noted, Eyton shows the existence of a vomer in *M. brasiliensis.* I may take cognizance of the presence of a large ossified sclerotic, which in *Momotus* (*Baryphthengus*) *ruficapillus*, as in *Eumomota superciliaris*, I have found thin and delicate.

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[*] P. Z. S. 1857, p. 258.

[†] Cat. Am. B. p. 262 (1862).

[‡] Mus. Hein. ii. p. 114.

As to sternum and shoulder-girdle, the notches are converted into foramina, as in *Momotus* and *Eumomota*, and they are of a size intermediate between these two forms. The extreme length of the breast-bone from the rostrum backwards is 1·4; greatest width posteriorly 1·1 inch. The coracoid is 1·1 inch long, the oblique sternal diameter shorter by 0·1 inch. In this respect it stands midway between the two genera compared, but with proclivity towards *Eumomota.*

Excepting in dimensions, the pelvis has no feature peculiarly its own. Its characters, as that of *Eumomota*, are shortness, posterior breadth and flatness of the dorsum. The præacetabular and postacetabular areas are subequal in length. The width of the latter is much greater than its length. The fore ilia lie widely out, and with little obliquity of tilt. There is only an indication of shelving of the horizontal ridge dividing postilium from ischium. The tuberosity, the spine, and the ischiatic space are alike short, the former, however, being widish. The inner anterior iliac borders do not meet the neural spine and convert the muscular spaces into foramina, as is the case in the Touracous.

Pelvic dimensions:—extreme length 1·2; greatest width (at ischia) 1 inch.

The humerus is stout, of moderate size, and the shaft is bent upon its long axis outwardly in the upper and backwardly in the lower half. The radius has a thickish shaft in relation to that of the ulna. In pattern the metacarpus is identical with that figured of *Eumomota* (figs. 26–31), but a little larger. There is a well-marked and roughened process above, where the thumb articulates, and in approximation to the first carpal bone during extension of the wing. The second outer moiety of the metacarpus is laterally flattened, rough, and it appears to be that portion of the united bone which descends lowest.

The femur is about one third shorter, and more slender than the humerus. The tibia is not equal to the ulna in stoutness of shaft; but its ends are quite as large. The tibial crest is short, sharp, knife-like, and moderately prominent. The external tuberosity is fair-sized, and hides the head of the fibula as looked at from the front. The fibula is short, and its lower half rests against a compressed ridge of bone outstanding from the upper end of the tibial shaft. There is a small bridge of bone between the inferior condyles of the ulna, and through which the extensor tendons pass. The tarso-metatarse (fig. 43) has a triangular shaft of goodly extent. The bifid or deeply grooved calcaneal process possesses but a single perforation for the passage of the flexor tendons. The grooving of the shaft on the inner side of this is large and deep; and the anterior fluting of the upper half of the bone forms also a considerable impression. As regards the three inferior knuckles, they are parallel, and the middle descends a shade the lowest. The metatarsal element of the tarso-metatarse is short, stout, and pyriform. The toe-bones have the usual numbers 2, 3, 4, and 5. The phalanges sensibly shorten distally.

The measurements, &c., of the limb-bones are as under noted:—

Momotus (*Baryphthengus*) *ruficapillus.*

	Humerus. in.	Ulna. in.	Meta-carpus. in.	Mid phalanges. in.	Total length. in.
Wing	1·7	2·15	0·85	0·6	5·3
	Femur.	Tibia.	Tarso-metatarse.	Mid-toe phalanges.	Total length.
Leg	1·2	1·95	1·2	1·1	5·45

Without wishing to tire by too long and dry detail, I nevertheless insert here a series of calculations of the proportional long diameters of the wing- and leg-bones. In my paper on the Green Tody, *T. viridis* (P. Z. S. 1872), I endeavoured to show in what respect that long-shanked bird bore consanguinity to the Motmots and Kingfishers. In so doing I necessarily laid some stress on the tarsal elongation and other limb-peculiarities. I had not then the Motmots at my command, and quoted Eyton's measurements. I since find the ulnar length he gives of *M. brasiliensis* questionable, and in this place, as appropriate, rectify chance of error in false data and conclusions.

	Momotus (Baryphthengus) ruficapillus.	*Eumomota superciliaris.*
Ulna to humerus	126 : 100	126 : 100
Metacarpus to humerus	50 : 100	48 : 100
Mid digit to humerus	35 : 100	37 : 100
Tibia to Femur	162 : 100	162 : 100
Tarso-metatarse to femur	100 : 100	100 : 100
Mid anterior toe to femur	91 : 100	100 : 100
Humerus to wing	32 : 100	32 : 100
Ulna to wing	40 : 100	40 : 100
Metacarpus to wing	16 : 100	15 : 100
Mid digit to wing	11 : 100	12? : 100
Femur to leg	22 : 100	21 : 100
Tibia to leg	35 : 100	36 : 100
Tarso-metatarse to leg	22 : 100	21 : 100
Anterior mid toe to leg	21 : 100	21 : 100
Femur to humerus	70 : 100	59 : 100
Tibia to ulna	90 : 100	59 : 100
Tarso-metarse to metacarpus	141 : 100	123 : 100
Mid. ant. toe to mid. dig. of wing	183 : 100	160 : 100
Leg to wing	103 : 100	89 : 100

The tongue-bone of birds is usually developed or built up by three centre-pieces in a line, and a pair of retro-current styliform forks, containing each two or three segments. Altogether they compose the hyoid arch, or are equivalent (*cæteris paribus*) to the branchial arches of fish. In the adult *M. ruficapillus* the three median elements are soldered together—the fore part (glossohyal) being stoutish and truncate, the middle (basihyal) laterally indented with facets for the articulation of the side-pieces, and the posterior (urohyal) flatter and spatulate. The anterior segments of the side-rods (cerato-hyals) are bony, the smaller tendors piece behind cartilaginous. It is the latter which connects the arch with the skull, and the median fore piece which enters into the substance of the tongue*.

Having run through the skeletal peculiarities of this supposed generically distinct Motmot, it devolves upon me to register the assertion that these do not support the assumption. It becomes a question, then, whether the anomaly of 10 tail-feathers, the middle non-spatulate, is sufficient in itself to elevate the bird to the rank of a genus!—an opinion I certainly for one would not adopt†.

IV. EUMOMOTA-SUPERCILIARIS *skeleton generally.*

The specimen of this genus at my disposal is one which was presented by Mr. Osbert Salvin to the Museum of the College of Surgeons in 1867. The bones have all been separated during maceration, which admits a good study of them individually. The first glaring fact is that the skull and sternum, to general appearance, are so like *Momotus* that there is a difficulty in conveying in words the distinctive shades of difference. When the inequality of size is taken into account the points seem more cogent.

With regard to the breast-bone, its sternal plates, like those of its *confrères*, are widish and shallow; but the clefts or xiphoid spaces are larger and deeper—the pedate processes, however, all joining, so that the spaces are not deprived of the character of foramina. Keel and rostrum as in *Momotus,* but the costal processes are proportionally a trifle shorter. Relatively and absolutely the coracoid of *Eumomota* is shorter, being subequal to the oblique sternal diameter; the epicoracoid is broader, and the shaft a grade stouter. The scapula posteriorly tends to increase of curvature.

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* The technical names of the different bones of the hyoid apparatus above given are those in most general use amongst comparative anatomists. But I must be just to my friend Mr. Parker, and mention that in his valuable contribution on *Gallus domesticus* (Trans. Roy. Soc. 1869) he dissents from the older views as regards the homology and nomenclature of the tongue-bones.

† [We think Dr. Murie hardly puts this fully. Up to the present point of the discussion the admissibility of the genus *Barypthengus* not only rests upon the characters of ten tail-feathers, the central ones being non-spatulate, but those characters plus certain osteological ones Dr. Murie has taken pains to point out, and plus certain others which we think will be seen by comparing the maxillo-palatine bones in the two figures of *B. ruficapillus* and *M. lessoni.*

For specific characters *B. ruficapillus* has no need to appeal to its osseous structure; and, viewing the Momotidæ as a whole, there is no difficulty in defining what may be called its generic characters. This is more than can be said for perhaps one half of the genera of birds.—ED.]

The beak is exactly of the same length as in *M. lessoni*; the latter bird, therefore, has a preponderance in long diameter of the orbito-occipital regions. The premaxillary depth is less in the first, particularly the culmen. Although in *Eumomota* the breadth of the beak seems greater than in *Momotus,* this only applies to its anterior half; for in the latter genus its basal segment is decidedly widest. In the former the nostrils come further back or cut more into the nasals. Its horizontal palatal plates are altogether narrower. The breadth of the frontal between the orbits is alike in each genus—therefore, other things being equal, relatively widest in *Eumomota.* As in the posterior or cerebral segment there is little difference of fore and aft length between the two forms, it follows that the mid or orbital segment of *E. superciliaris* is the chief part wherein curtailment of the skull is effected. *Momotus* undoubtedly has the wider skull occipitally; but the antero-posterior diameter of this part is little, if at all, over what obtains in *Eumomota.*

The mandibular length in the last mentioned is 2·15 inches; of this, the shallow symphysis front-joining portion is 0·85 inch. The bone altogether is low or shallow, and with a slight curvature corresponding to the beak-deflection. There is no so-called "dentary space" or median fissure, this being obliterated by an ossific plate. The inner and posterior mandibular angles are each well marked.

The only appreciable change of pelvic formation from *M. ruficapillus* is in the præacetabular being a shade longer than the postacetabular region; and there is a small foramen in front of the hip-joint or acetabular perforation.

Concerning the shape of the bones of the extremities, what has been said of the preceding type applies in this case. Proportions have already been denoted; the subjoined are the measurements from which the calculations are derived.

Eumomota superciliaris.

	Humerus.	Ulna.	Metacarpus.	Mid phalanges.	Total length.
Wing....	1·35 inch,	1·7	0·65	0·5?	4·2?

	Femur.	Tibia.	Tarso-metatarse.	Mid-toe phalanges	Tot. length.
Leg	0·8 inch,	1·35	0·8	0·8?	3·75

I made out, in all, thirty-six vertebræ, free, conjoined sacrally, and otherwise. The numbers regionally I could not determine.

The trachea is composed of complete bony rings, each narrow and delicate. I presume there are in all about thirty; for I noted twenty-six separate and four or more joined together at the lower larynx. This has no expansion as in some of the Anatidæ, &c.

The tongue-bones follow the pattern of *Baryphthengus ruficapillus,* but are not so stout; and the urohyal is less expanded.

If *Eumomota* is worthy to be segregated as a genus, it is well to remember that its osseous specialities are not many, though possibly leading away from those of *Momotus* in degree rather than kind. To wit, it possesses a shallower skull, though less level frontally; the orbital circuit tends to diminution; the beak and lower mandible are relatively wider throughout and not quite so decurved anteriorly; the xiphoid spaces are somewhat longer, the coracoids shorter; the proportions that the bones of the leg bear to those of the wing evince shortening.

V. *The Alliances of the* MOMOTIDÆ *osteologically considered.*

Whilst the group in bony conformation singularly resemble each other, yet there is a serial gradation wherein *Prionirhynchus* represents one and *Momotus* the other extreme. In the absence of a thorough examination of the former (or of *Hylomanes*), I must perforce refer to *Eumomota* for detail in exemplification of the broader-billed division.

1. *Comparison with the Todidæ.*—I restrict this family to the Green Tody (*Todus viridis*) and its immediate species, thus excluding *Todirostrum* and such like forms of the Tyrannidæ which

were at one time associated with it. In *Todus* we have a bird not half the size of *Eumomota*; yet, when the skeleton of the former is enlarged to double its natural dimensions, as I have done in plate lv., P. Z. S., 1872, an excellent comparison can be instituted. This much is at once apparent, that the Motmots are stamped with a positive bond of osteological affiliation with the Tody. Therefore this is one direct line of their affinities.

The skeletons of *Eumomota* and of *Todus* undoubtedly approach each other in the annexed particulars:—

In shape, relative length, flattening and shallowness of the præmaxillæ; in position and size of the nostrils; in ascent and figure of the cranial parts behind; in condition of post-frontal and zygomatic processes; in constitution of the palatines and maxillo-palatines; in the disposition of the pterygoids; in the mandible as a whole; in four notches to the sternum and in its shape generally; in the nature of the furcula and coracoids; in the relatively short, wide and shallow pelvis; in vertebral numbers; in torsion of the humerus; in morphological development of tarso-metatarse, and especially its extremities; in the proportions of metacarpus to humerus, of tibia to femur, of femur and of tarsus to entire leg; lastly in the arrangement of the toes and syndactyle foot.

The same genera, nevertheless, in their skeletal characters diverge by the following gradations:—

In the proportionate length of the beak to the skull behind, being longer in *Eumomota* than in *Todus*; in the ossific variation of the interorbital septum—a small space only in the former, none in *Momotus*, and a large one in *Todus*; in *Todus* having a considerable-sized lachrymal, the lower limb reaching to the jugal; whereas in *Eumomota* and *Momotus* prefrontal and ethmoidal processes are well developed, and they are only moderately so in *Todus*; in the latter bird having broad mid frontals, and they are wide in the former; somewhat the same relations of parts as regards palatal plates; in the occiput of *Todus* being more full and rounded, whilst in *Momotus* and *Eumomota* the temporal groove is better impressed. The sternal notches are quite open in *Todus*, but terminally connected or converted into large foramina in the Motmots. Of the pelvis, proportionally, its breadth to length is greater in the latter than in the Tody. In the proportions of limb-bones, the Momotidæ and Todidæ stand considerably apart as regards length of ulna to humerus, tarsus to femur, tibia to entire leg. In *Eumomota* the proportional length of the femur to the humerus and of tibia to ulna falls considerably short of what obtains in *Todus*; but *Momotus* precisely agrees with the latter. The Motmots are unlike the Tody as respects length of metatarse to metacarpus, and of entire leg to entire wing.

Thus, all things considered, the two families have characteristic points in their skeleton denoting formation of a kind further removed than what I hold signifies generic import. At the same time there is unity of type. Thus the two, as I shall again notice, ought to come under one division or group.

2. *Comparison with the Coraciidæ.*—Among the Rollers we have extremes analogous to what obtains among the Motmots, viz. narrow and broad-skulled individuals. This repetition is exemplified in *Coracias* and in *Eurystomus* &c. I shall lay more stress on *Coracias*, which exhibits closer resemblances to *Momotus* than to *Eumomota* and possibly *Prionirhynchus*.

C. garrula affords a familiar example; and in analyzing its skeleton point by point I observe the subjoined agreements between it and *Momotus*:—

Fair arching of the premaxillary region; situation of the nostril and moderation of culmen; a considerable-sized orbit; likeness in parieto-temporal grooving and occipital facies; interorbital and postorbital width; spongy maxillo-palatines, which meet mesially. The horizontal palatal plates posteriorly are spineless and round off at the corners.

On the other hand, so far as the skull is concerned, differentiation and contrast are as plainly exhibited in those particulars which I append.

In *Coracias* the beak is but half the length of the entire skull. There is no distinct transverse facial hinge, the premaxillary rods running in a wedge-like manner into the prefrontals. The post-premaxillary depth is relatively greater, the anterior moiety of præmaxillæ narrower; and there is a width and rounding of the top of the beak compared with *Momotus*. In *Coracias* there is a separate and large supranarial foramen; in *Momotus lessoni* this is represented only by a minute orifice; and in *M.* (*Baryphthengus*) *ruficapillus* it is confluent with the nostril. The circumscription of the orbit through the postfrontal process descending to the jugal is a characteristic feature of the Coraciidæ. In *Coracias*, at least, there is a deep prefrontal indent, and the upward obliquity of the skull thence is greater than in that compared, as also is the perpendicular occipital surface. Pterygoids proportionally longer than in the Motmots. The premaxillary margin overhangs the mandible; the rami of the latter are deeper, and the shortening and scooping of the symphysis are markedly stronger, in the Coraciidæ.

As to the sternum, it is longer according to width, the notches deeper and not converted into foramina. Coracoids shorter than oblique sternal diameter; epicoracoids broader. Scapula straighter. The pelvis is narrower in proportion to length, and the ischial portion produced more, than in the Motmots.

In some of the species and genera of the Coraciidæ the points of divergence from the Motmots increase. *C. bengalensis* has an interclavicle and postpalatine spines, along with a shorter tarsus. In *Eurystomus* (*E. australis*) still greater changes obtain; and while the beak and skull posteriorly broaden, they are abbreviated.

I find in *Coracias abyssinica* the proportionate lengths of the tibia, tarso-metatarse, and mid toe to be considerably less than in the Motmots and Tody, and the same diminution to excess in all the bones of the leg to the corresponding ones of the wing.

3. *Comparison with the Meropidæ.*—In their sternal apparatus the Bee-eaters retreat from the previous groups. It is more elongate and narrow in them, has deeper clefts, long slender xiphoids; the rostrum (at least in *M. apiaster*) is trifid, and in *M. melanura* is not excavated; in all the keel is less emarginate anteriorly. The coracoid is remarkably short, and inferiorly extraordinarily wide; furcula expanded above; scapula relatively broader than in the Motmots. Pelvis deeper and longer in proportion to breadth. The inordinate length, curvature, and tenuity of the beak in such forms as *Merops cyanotis*, *M. melanura*, &c., doubtless with a certain depth of mandible (as Alph. M.-Edwards, *l. c. infrà*, pl. 165, has figured in

that of *M. amictus*), slender palatines and maxillo-palatines, smaller size and forward position of the nostril and other points, take away from the Momotine type.

But it is also as patent that there are many osteological relations of proximity. There is posterior breadth of the skull, a transverse beak-hinge, interorbital ossification, rounding of post-palatal plates, short pterygoids, a delicate vomer; the lachrymal is joined to the prefrontal processes, and, inferiorly, is very delicate, in some species being replaced by membrane below, as in *M. melanura* (which also, I find, has a minutely serrate edge to beak, and the tongue-bones as in *Eumomota*). The legs are slender; but the construction of the tarsus is nearly as in *Momotus*, though the calcaneal process is more elongate and sideways but with one basal perforation. The $\frac{3}{1}$-toed foot is truly syndactyle.

4. *Comparison with the Alcedinidæ.*—Among the Kingfishers, without taking colour into consideration, there are four genera, at least, which carry exterior resemblances promising affiliation to the Motmots. These are:—the Papuan form *Syma*; *Tanysiptera*, also confined to the neighbourhood of the same region; *Myoceyx* and *Ispidina*, African birds. *Syma* notably has a serrate mandible. *Tanysiptera* 10 rectrices, the median pair long and spatulate. The figure of the relatively shallow beak of *Myoceyx* and *Ispidina*, and other general characters, in the same way suggest Motmot resemblances. It is to be regretted that no skeletons of the first three genera exist in this country. I must confine remarks, therefore, to the fourth, while incidentally glancing at points in *Dacelo* &c.

The Halcyoninæ, and with them *Ispidina*, possess a skull whose contour and general proportions approximate to *Momotus* and *Eumomota*, and yet is impressed with a cast peculiarly its own. For instance, the lower mandible is far more acute and bony, its bridge longer—roughly speaking, half the mandibular length in them, and a trifle over one third in the Motmots. The Kingfisher group more immediately under consideration have less curved, more conical præmaxillæ, with a depression existing at the frontal root. The brain-segment of the Motmot skull is decidedly broader, higher, and less rotund than in these Kingfishers. The latter have a large lachrymal, whose inferior limb is inflated and spongy. Their interorbital septum has a large unossified space; and there is a groove immediately in front of the postfrontal process—the latter short, the orbit gaining accordingly. The temporal grooves in the Kingfisher well nigh meet; they are mesially wider apart in the Motmots, therefore causing the occipital facies to be fuller. Instead of a linear separation, with flatness of maxillo-palatines, which characterizes the latter, the former have them thoroughly joined together inwardly; and at this point they are deeply grooved, and shoot back and up into the cleft behind. The broader palatal plates spined posteriorly, and reduced postnarial aperture again distinguish Kingfisher from Motmot, besides other minor detail of parts. Still, one thing with another, there is no gainsaying the fact that the two avine types share many features in common in cranial composition and its lineaments generally.

The Dacelonine skull departs in beak-breadth, elongation of upper lachrymal limb, and sundry other particulars. The Alcedine section run off at an opposite tangent, and therein pursue a course affining them with the Bee-eaters.

The pelvis of the Halcyoninæ offers strong resemblances to the Motmots. The sternal apparatus, however, has less agreement, this section of the Kingfishers having an upper furcular spur, a greater anterior emarginate ploughshare keel, open notches, and a breastbone longer relatively to its breadth than obtains in the Motmots.

In the proportions of limbs and their segments to each other my researches show that the wing-bones of the Momotidæ and Alcedinidæ do not widely differ. Such is not the case with the leg, where in all the latter the tarsus is relatively shorter, and in *Ceryle* no more than half what obtains in the Motmots. As regards proportions of the entire length of the leg to wing, *Eumomota* bears towards the *Halcyoninæ*; but this section and *Momotus* much exceed the rest of the Kingfishers in this respect.

5. *Comparisons with other Families*—I may asseverate that the foregoing bird-groups, taken all in all, are those which in skeleton come nearest the Momotidæ. It is not so essential, then, that I should follow the minutiæ of the bony constituents of other presumed allies further than by referring to a few of the more obvious points.

Concerning the yoke-footed and $\frac{3}{1}$-toed Bucerotidæ, as Alph. Milne-Edwards observes*:—"Il est impossible de confondre le tarso-métatarsien des Calaos avec celui d'aucun autre oiseau; cet os est très-enflé et remarquable par l'existence de deux pertuis supérieurs énormes qui servent en même temps de trous pneumatiques." Their sternum has but one pair of xiphoid notches; and in a variety of ways their skull is vastly different from that of the Motmot's.

The foot of the Trogonidæ is $\frac{2}{2}$-toed; the first and second are those thrust behind. The upper extremity of the tarsus has a most unusual elongate posterior process, and two perforations at the side; the lower end of the same bone has an enlarged external knuckle (trochlea), and the internal one thrust backwards. The pelvis is short and broad to an extreme, the ischium long. There is an interclavicle (at least in *Trogon mexicanus* and *T. atricollis*); and the coracoids meet inferiorly. The skull is broad and short, more Swift-like than that of the Motmots. There is a considerable interorbital space. Maxillo-palatines reduced to narrowed extending plates. An extensive palatal and postnarial cleft, and the palate-plates narrower. Basipterygoid processes obtain. All these are most important and trenchant distinctions from the Momotidæ.

The skull of the Jacamars, judged by *Galbula leucogastra* (the broader-billed section, *Jacamerops*, &c., not having come under my observation), has a very different form from that of the Motmot's. There is attenuation of the beak, a short lofty brain-division, descent of the postfrontal process to the jugal, &c. Their sternum, with part likeness to *Todus*, has great fissures and delicate rods. Their tarsus and the zygodactyle construction of the foot also exclude their close relation to the Motmots, advocated by some.

Lastly, as to the Ramphastidæ, Toucans. Their zygodactyle foot coordinate with adaptive alteration of the lower end of the tarsus, peculiar enlargement of the bottom of the femur, pelvic elongation, forward lengthening of sternal keel, division of the clavicles (united in *Pteroglossus*), and upper enlargement of each half, great beak, and other cranial peculiarities sufficiently distinguish their skeleton from the Motmot type. Doubtless such a form as *Aulacoramphus* is considerably modified, especially as regards skull, which *en tout ensemble* bears a resemblance to that of *Momotus*; but a critical review of its composition less sustains the idea.

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* 'Recherches sur les Osseaux Fossiles de la France,' tome ii. p. 305, and Atlas, ii. pl. clxix. figs 24, 25.

VI. *Compendium of Facts and Opinions on the Motmots.*

The literature having reference to the Motmots may conveniently be arranged into six different foci, which I shall curtly review.

1. *Figures.*—The subjoined list of names[*] indicates those forms of which good illustrations are extant.

- Prionirhynchus.
  - *P. carinatus.*
  - *P. platyrhynchus.*
- Eumomota.
  - *E. superciliaris.*
- Hylomanes.
  - *H. momotula.*
- Baryphthengus.
  - *B. ruficapillus.*
- Momotus.
  - *M. lessoni.*
  - *M. cæruleiceps.*
  - *M. mexicanus.*
  - *M. swainsoni.*
  - *M. brasiliensis.*
- Urospatha.
  - *U. (M.) martii.*

The presumed species *Momotus nattereri, M. microstephanus, M. subrufescens, M. æquatorialis,* and *M. castaneiceips* appear hitherto not to have been figured, a description sufficing to establish their identity and closeness to or variation from an acknowledged species.

2. *Habits.*—The travellers Don Felix Azara[†], Levaillant[‡], Waterton[§], and Schomburgk[‖], individually, graphically relate facts concerning the live Motmot in its wild state and in captivity. We are also indebted to Swainson[¶] and Sir William

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[*] The synonyms and exact reference to publications are to be found in Sclater's 'Catal. of Amer. Birds,' and P. Z. S. 1857, and in Cab. et Hein. 'Mus. Hein.' &c. Half of the above have been figured by Jard. & Selby, 'Ill. Ornith.'; the remainder by Levaillant, Spix, Swainson, Des Murs, Vieill., Gray, Licht., Leadb., and Sclater.

[†] Apuntamientos para Paxaros del Paraguay. [‡] Ois. de Par. tome i.

[§] Wanderings.

[‖] Reis. in Brit. Guiana; and "Ueber *Prionites momota*," Naumannia, 1851.

[¶] Zool. Illus. 2nd ser.; and Nat. Hist. and Class. of Birds, vol. ii.

Jardine* (through Mr. Kirk, a friend of his) for some interesting information on moot points. Other descriptions of a miscellaneous kind are to be found scattered through various volumes.

The birds are solitary, or live in pairs, preferring the shady recesses of the forest. They sit motionless on a low branch, often in nooks near rivulets, wherefrom they dart on their prey. Swainson says they catch their prey on the wing (Fissirostres); but Kirk avers that they alight to seize it. Ordinarily their food is insects, reptiles, and fruits. In captivity a bold mistrusting bird, the Motmot will then eat bread, raw meat, oranges, water-melons, small birds, mice, lizards, snakes, cockroaches, &c. On pouncing on these latter, they afterwards strike them violently against the ground or perch. Songless, their only cry is "Houtoo." They breed in holes, and about May lay three or four dusky cream-coloured eggs. Sexes undistinguishable; and the young scarcely differ except in the more downy texture of their feathers. Primaries shed at the first moult. The story has found credence that they nibble off the occasionally absent vanes of the long middle tail-feathers; but this notion has been contradicted.

3. *Structure other than skeletal.*—The more important points of their internal organization have been recorded by several observers †. Œsophagus wide; proventriculus moderate; stomach small and oval, inner coat coriaceous, muscular wall only of moderate thickness. Intestines narrow; cæca long, and situate near the end of the gut; cloaca large. Tongue lengthened, bifid for half an inch, and feathered at the sides. Jardine says of the muscles of the larynx that they appeared to him to resemble in number and position those of the Corvidæ (?).

Their syndactyle foot is moderately adapted for terrestrial progression (Blyth). Tarsus scutellate; mid anterior claw with an expanded inner edge. Beak Corvine, margins denticulate;

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* Ann. of Nat. Hist. 1841, vol. vi. p. 321.

† Among these I may refer to:—Jardine's (*l. c.*) notice of the viscera of *Momotus Swainsoni* (*Prionites bahamensis* of Swain.): Giebel on the tongue, 'Zeitsch. f. Gesam. Naturwiss.' Halle, 1858, p. 27, tab. i. fig. 37 (his figure in outline from above does not show the cleft tip so markedly as in Jardine's woodcut); Macgillivray, 'Brit. Birds,' vol. ii.; Blyth, 'Mag. Nat. Hist.' vol. ii.; Nitzsch, 'Pterylographie,' &c.

the small round nostril is nearly basal and bare; rictal vibrissæ few and unobtrusive. Plumage loose-webbed; contour-feathers with an axillary plume; spinal tract without a space; wings rather short and rounded. Remiges 21; the first four graduated, 4th, 5th, and 6th longest; rectrices graduated, numbering 10 and 12; and in nearly, but not all, the central ones are long and with a racket. Oil-gland elongate, oval, and naked.

4. *Generic Diagnosis.*—The group has been divided into six genera, partly on account of the nature of the tail-feathering, and partly on the conformation of the beak. The characters given are:—

Momotus. Long compressed rostrum; strongly serrate mandible; a long tail, with 12 rectrices, the two middle spatulate.

Urospatha. Mandible like preceding; 10 tail-feathers, median pair terminally spatulate*.

Baryphthengus. Beak as above; 10 rectrices, non-spatulate.

Hylomanes. Weaker somewhat dilate rostrum, less incurved and finely serrate; a short tail, non-spatulate, with 10 feathers.

Prionirhynchus. Long, dilate, carinate, incurved, finely toothed beak; 10 rectrices, median long and spatulate.

Eumomota. Less carinate, dilate, and curved rostrum than last, middle only of margin serrate: 10 rectrices, graduated, truncate apically, two middle spatulate.

5. *Geographical Distribution.*—Dr. Sclater† remarks:—"The Motmots are a purely tropical American family, occupying an area nearly coequal with that of several other characteristic groups belonging to the same fauna. From Southern Mexico, where two species occur, they extend through Central America and some of the more Southern Antilles, over the whole of the eastern portion of South America, as far southwards as south-eastern Brazil and Paraguay, where a single species is found. Their true focus seems to be Central America, where the greatest number of species and the most characteristic forms occur."

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* In the Atti della R. Accad. d. Sci. di Torino, 1869, vol. iv. p. 180, Dr. Salvadori forms the new genus, *Urospatha*, limited to one species, the *Prionites martii*, Spix (*Baryphonus* and *Momotus semirufus* of Sclater). See also notice in 'The Ibis,' 1869, p. 222.

† P. Z. S. 1857.

6. *Their supposed affinities.*—In the 'Systema Naturæ'[*] of Linnæus, *Momota* comes under *Rhamphastos,* between the Psittacea and Buceros. Buffon[†] places in sequence the Anis (Crotophaginæ), the Houtou (Motmots), the Huppe (*Upupa*) *Promerops,* and the Guépiers (Meropidæ). Cuvier, in his 'Règne Animal,' ranges under his syndactyles the Bee-eaters, Motmots, Kingfishers, Todies, and Hornbills, in the order here given. Vieillot[‡] says of *Prionites*:—"Cette famille se compose des genres *Motmot* et *Calao.*" Latham's arrangement[§] runs:—Parrots, Toucans, Motmots, Australian Channel-bird (*Scythrops*), Hornbills, Beef-eater (*Buphaga*). Lesson[||], who studied the group circumspectly as to specific forms, locates them in the family Bucéridées, containing Motmot and Calaos (*Buceros*)—thus following Vieillot, but altering the title of the group.

Swainson[¶] took up the subject warmly, and ran a tilt with all and sundry, unquestionably bringing forward cogent reasons for their separation from the Toucans. But he goes to the opposite extreme in classing them under the Trogonidæ, and as the nearest form to the Jacamars (*Galbula*). Blyth[**] strings in linear order his Cylindrirostres, containing Meropidæ, Coraciidæ, and Halcyonidæ, his Angulirostres combining Todidæ and Galbulidæ, his Serratirostres composed solely of Prionitidæ (*Motmots*), and his Levirostres, wherein are the Rhamphastidæ and Musophagidæ. He observes:—"Thus, although no passage exists from the Motmots into the Kingfishers or into the Toucans, and although the Kingfishers and Toucans differ materially, yet the interposition of the Motmots so connects those two other groups, that they cannot be ranged with either of them to the exclusion of the other; and the Toucans, in like manner, combine the characters of the Motmots and Touracos, &c."

Nitzsch's[††] pterylographic studies lead him to class in his

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[*] 12th ed. 1788, vol. i. p. 357.

[†] Hist. Nat. 1818, vol. xi. p. 333.

[‡] Dict. d'Hist. Nat. vol. xxviii. p. 153.

[§] Hist. of Birds, 1822, vol. ii.

[||] Manuel d'Ornith. tom. ii. p. 103.

[¶] Classification of Birds, vol. ii.

[**] Mag. of Nat. Hist. 1838, vol. ii. pp. 318 & 422, &c.

[††] Pterylographie, &c., Eng. Trans. Ray Soc. 1867.

Picariæ a group, the Todidæ, comprehending *Coracias, Merops, Prionites, Todus,* and *Galbula.* Jardine* thought the Motmot's position would ultimately be found to be that assigned by Swainson, remarking, at the same time, that their analogies towards the Crows are extremely strong.

Bonaparte† threw the families thus:—Trogonidæ, Galbulidæ, Alcedinidæ, Meropidæ, Prionitidæ, Coraciidæ, Eurylaimidæ, Cotingidæ, and Todidæ. Gray and Mitchell‡ well nigh reversed the order, their Coraciadæ containing Coracianæ, Todinæ, Eurylaiminæ, Momotinæ, Trogonidæ—the Alcedinidæ, with Bucconinæ, Halcyoninæ, Alcedinæ, and Galbulinæ following. In his commentary thereon Strickland§ says:—"The Momotinæ are evidently only the American group of the Bee-eaters, and might, I think, be included with them as a subfamily, Meropinæ, of the Halcyonidæ."

The Motmots (Prionitidæ) are also closely related to the Trogons, and may be considered an offshoot of them, or of the Bee-eaters, parallel to the Jacamars. Such is Wallace's|| opinion; whilst Blanchard¶ suggests of the group:—"Se lient évidemment par beaucoup de caractères aux Guépiers [Bee-eaters]; ils semblent jusqu'à un certain point représenter dans le nouveau monde ces derniers qui n'habitent que l'ancien continent." Then follows *Alcedo* &c. In the Catalogue already quoted, Sclater assigns six families to his sectio Brachychires, ordo Fissirostres. In succession these are Momotidæ, Todidæ, Alcedinidæ, Galbulidæ, Bucconidæ, and Trogonidæ.

The osteological position of *Momotus* Eyton** makes in his family Buceridæ, along with the Hoopoe and Hornbills, the family Alcedinidæ, containing Rollers, Tody, Bee-eaters, Jacamars and Kingfishers, going before. In Huxley's†† tabular notice Meropidæ, Momotidæ, and Coraciidæ take a place among his $\frac{3}{1}$-toed Coccygomorphs. Neither is Alphonse Milne-

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* Paper cited. † Conspectus. ‡ Genera of Birds.

§ Ann. of Nat. Hist. 1841, vi. p. 417, and "Map of the family Alcedinidæ," vol. vi. pl. 8.

|| Ann. & Mag. Nat. Hist. 1856, 2nd Ser. vol. xviii. p. 198.

¶ "Ostéologie des Oiseaux," Ann. d. Sci. Nat. 1859, tom. xi. p. 117.

** "Osteologia Avium." †† P. Z. S. 1867, p. 467.

Edwards* very explicit, but appears to regard the Momotidæ as allied to the Bucerotides among the Syndactylinæ. Reinhardt† locates *Momotus ruficapillus* immediately after *Ceryle* (Kingfishers). Sharpe‡, through *Ispidina* and *Myoceyx*, hints linear connexion from the Kingfishers to the Todidæ and Momotidæ.

VII. *Conclusions derivative from data given.*

Definitions of a tentative kind, whereby subdivision of the family may be recognized seem to me a difficult matter. In short, as much as my research among the group enables me to tender an opinion, the Motmots barely admit of such a thing as stable genera, so intertwined are their structural relations. Regarding figure of the beak, as Plate XV. shows, the gradation from the narrow to the broad variety is the reverse of sudden. The magnitude of the mandibular serrations almost bears a ratio to the size of the bird. The length of the tail-feathers from one form to another is a series from shorter to longer; even the possession of a racket to the tip of the elongate median rectrices of some is deemed to be but a question of moult and age of the bird. Thus the main differentiation to be depended on is ten rectrices in some and twelve in others. Plumage, as part and parcel of the tegumentary appanage, is notoriously subject to irregularities of development dependent on a variety of secondary causes. This circumstance, especially, weighs, as but a modicum of information is known respecting the frequency and succession of changes induced during moult and age in the Motmots.

I have already intimated that *Baryphthengus* compared with *Momotus* has no skeletal or organic character other than deviation in its tail-feathers; and this anomaly pertains to *Urospatha*. The assumed more dilate and finer-toothed beak of *Hylomanes* is one of slight degree, not kind; whether its osteology may offer singularity is dubious, reasoning from the similarity of structure in the other forms. Proceeding to the two other assigned genera, and taking for granted that their broader carinate beak and osteological variation (as I have noticed in *Eumomota*) hold good as generic characters, it still does not seem to me advisable to separate *Prionirhynchus* from *Eumomota.* If partition there needs be, I would propose restriction to four genera:—

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* Oiseaux Fossiles, tom. ii. p. 300.

† Bidrag til Kundskab om Fuglefaunaen i Brasiliens Campos. Copenhagen, 1870.

‡ Map of the Family Alcedinidæ, in his Monograph of that group.

Momotus.—Narrow, moderately deep beak, large-toothed; leg-bones relatively long to the corresponding wing-bones; rectrices 12, graduated, median pair elongate and spatulate.

Baryphthengus.—With 10 tail-feathers; otherwise resembling the foregoing. (This genus would include *Urospatha.*)

Hylomanes.—Beak nearly as in preceding, but with smaller serrations; rectrices 10, very slightly graduated, short and without spatulation.

Eumomotus.—Broader, shallower, carinate beak, finely denticulate; leg-bones comparatively short to corresponding wing-bones; rectrices 10, graduated, elongate, two central ones spatulate. (The so-called *Prionirhynchus* comes under this heading.)

That the Motmots are entitled to be looked upon as a good family group, I think is attested by the remarkable similarity, dominant in all, and sufficiently distinct from their nearest fraternity to permit of their segregation as ordinarily understood in ornithology.

Basing affiliation on the radical type of the skeleton in its detail, on their internal anatomy, on the plumage, on their eggs, nest-construction, and rearing of young, and on their food and habits generally, the birds which best accord with the Motmots are the Tody, Kingfishers, Rollers, and Bee-eaters.

Of these, *Todus* in preponderance of particulars has the advantage of kinship. Its small size and curt tail affine it to *Hylomanes.* Its pterylosis (with axial plumes), long and thin tongue, large cæca, serrate beak, weak rictal bristles, habitat, insectivorous food, short flights, living in pairs, breeding in holes, colour of eggs, and osteological constitution generally, are, one and all, in the main essentially Momotine. Nitzsch very happily made the Prionitidæ and Todidæ companions; but Blyth, with a keen appreciation of characters, I think, was less fortunate in yoking *Todus* to *Galbula,* evidently being misled by, or laying too much stress on, similarity of the digestive organs, imperfectly known in the Motmots at the time he wrote.

Next in order the affinities of the Motmots lie between the Alcedinidæ and Coraciidæ; and balancing one thing with another, certain genera of the former exhibit more numerous points in their favour, though every thing depends on the value attributed to a given set of characters. The Kingfishers, as a group, are wanting in aftershaft to feathers; usually their tongue is short and somewhat rounded, cæca diminutive, rictal bristles absent, structural conditions the opposite of the Rollers' (*Coracias*), and approximating the latter to the Motmots. In some of the Rollers where there is elongation of the tail-feathers it is the outer and not inner ones; they are more often gregarious birds, strong on the wing; and their foot is less syndactylous, thus deviating in Momotine tendency. Again, among the Kingfishers, *Tanysiptera*, in having but 10 rectrices, the two median spatulate, bears a likeness to *Urospatha* and to *Eumomota* and its ally. *Cittura*, in its grooved culmen, repeats *Prionirhynchus*; *Myoceyx* and *Ispidina*, by short tail, resemble *Hylomanes*, whilst *Syma*, with serrate mandible and 12 rectrices, offers a counterpart of *Momotus*. Moreover in its tongue *Pelargopsis* differs from its brethren, and gains likeness to *Momotus*. The Bee-eaters (in genera) after the same fashion, approach and recede from the Motmots; but whilst yoke-footed and feathered like them and partly *Coracias*, they are truly birds adapted in minutiæ of structure for rapid aerial flight, and associate in flocks, &c.

The true reading appears to be that certain genera of each of the above families juts prominently towards the Motmots, these latter, in turn, inclining to the contrary dispositions. Thus it is hard to predicate of a family consisting of many members that they bear absolutely nearest relationship to another, the latter being as closely linked in an opposite direction. An explanation of these vagaries has been suggested by the theory of geographical representation, the Old-World Rollers, Bee-eaters, and Kingfishers, being represented in the American fauna by the Motmots, Jacamars, and Todies. This, however, leads to reflections away from the direct purport of the present communication*.

From my studies I look upon the Motmots, Tody, Kingfishers, Rollers, and Bee-eaters as a most natural assemblage, whereof one type of structural form is predominant. Skeletally they present a radical agreement; their pterylosis rests on a nearly uniform base, the soft parts of their anatomy are of a kind implying similarity of stock. With this stem to build a genealogical tree on, the branches and offshoots of necessity pursue multiform directions, and, where numerous and favoured by secondary influences, impress a character masking their original derivation and merging into that of neighbouring tribes. Blyth's arrangement of the *Syndactyli*, supported by the general organization of the birds so far as then known to him, is most excellent, although from his insertion of the Galbulidæ and separation of the Todidæ and Prionitidæ I dissent. Elsewhere I shall treat of their rank as a group cutting up Huxley's Coccygomorphæ, and in some points rather agreeing with the divisions adopted by Alph. Milne-Edwards. Meantime I restrict myself to bringing two families into juxtaposition, and succinctly noting their characters. If to these a term is necessary, Blyth's Serratirostres may be accepted.

The SERRATIROSTRES.

A section of the Syndactyle birds, composed of two families, and together possessing the subjoined attributes:—

The mandible denticulate; bill long, broadish, and tapering, but not deep; a few weak rictal vibrissæ; nostril roundish, bare, nearly basal; wings rather short and rounded; feathers with an after-plume; spinal tract without a space; tongue long and thin; stomach muscular; intestines with large cæca; palatal bars rounded posteriorly, and without spines; maxillo-palatines spongy, almost mesially united, and truncate behind; pterygoids short; bony nares large, oval; sternal keel moderately produced forwards, and anteriorly emarginate; coracoids relatively long; pelvis short and wide; humerus large in proportion to femur; calcaneal process of tarsus moderate-sized, and with a single perforation; vertebræ 35; food, chiefly insects; breed in holes, and lay white eggs; are solitary in habit or go in pairs.

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* There are other topics hinging on the natural history of the Momotidæ of an equally interesting kind, and well worthy of ventilation and discussion. Mr. Salvin, who drew my attention to Salvadori's genus and has otherwise tendered useful hints, surmises the possibility of a progenitor (*Momotus priscus*?) with 12 rectrices, and tells me of many circumstances in elucidation of geographical range, feather-spatulation, &c., which might cause me to modify opinions herein enunciated as to Momotine genera. On the other hand such conversation evokes latent thoughts of mine respecting ornitho-subdivisions and the physiological bearing of many subsidiary points. At all events, I trust he and other competent authorities on the group may supply a fresh chapter incorporating the latest data, be they subversive of my conclusions or the reverse.

All inhabitants of Tropical America.

Fam. Momotidæ.—Distinguished by:—a short or moderate tarsus; pronounced beak-serrations; premaxillaries greatly exceeding the length of skull behind; orbital septum almost entirely ossified; prefrontals broad; lachrymals diminutive or absent; temporal groove well marked and deepish; palate-rods of medium width; sternal notches converted into foramina; tongue terminally bifid, and laterally feathered; remiges 21; 10 or 12 graduated rectrices, short, moderate, or elongate, and two median occasionally spatulous. no caec

It possesses six reputed genera, which I am inclined to reduce to four.

Fam. Todidæ*.—Having a long tarsus; very diminutive mandibular serrations; premaxillaries only slightly exceeding skull's length behind; a very large interorbital space; prefrontals narrow; lachrymals of good size, their inferior limb reaching the jugal; temporal groove short and shallow; palate-rods narrow and slender; sternal fissures open; remiges 19; rectrices 12, and tail short and rounded.

Represented solely by the genus *Todus*.

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* Nitzsch's Todidæ comprises five families, and therefore is not equivalent to the present subdivision.

DESCRIPTION OF PLATES.

Plate XIII.

Illustrations of the bones of the cranium and shoulder-girdle of *Momotus lessoni*, of the natural dimensions.

Fig. 1. The inferior or palatal surface of the skull: *m x p*, maxillo-palatine.
Fig. 2. Upper cranial view: *n*, nostril or anterior nares, partially divided by a septum.
Fig. 3. The right quadrate bone, seen from the inside.
Fig. 4. The inferior articular knuckles of the same. The letters to this and the preceding figure are:—
o l, orbital limb; *i*, internal, *e*, external, and *p*, posterior knuckle for articulation with the lower jaw.
Fig. 5. Occipital facies of the skull: *p f*, postfrontal process.
Fig. 6. A profile view of the cranium without the mandible: *f*, fissure or cleft between the ethmoid and maxillary segments; *e p*, ethmoidal process; *f p*, prefrontal process; *z*, zygomatic process.
Fig. 7. Sternum and shoulder-girdle, from the side.
Fig. 8. The same, on its inferior surface.
Fig. 9. Partial view of the inside of the sternum, to show *r c*, rostral cavity or excavation.
Fig. 10. The head and tongue of *Momotus swainsoni* (*Prionites bahamensis*, Swain.), after Sir W. Jardine: *t*, tongue.

Plate XIV.

The skeleton of *Eumomota superciliaris.* Excepting figs. 30, 31, 40, and 41, all are drawn to natural scale.

Fig. 11. The pelvis, its interior surface.
Fig. 12. Dorsal aspect of the pelvis.
Fig. 13. A lateral view of the pelvis.
Fig. 14. Lower or pectoral surface of the sternum.
Fig. 15. The sternum in profile.
Fig. 16. A side view of the skull.
Fig. 17. The mandible, also seen laterally.
Fig. 18. Upper surface of the skull.
Fig. 19. Its inferior or basal aspect.
Fig. 20. Superior or oral superficies of the lower jaw.
Fig. 21. The right humerus, its posterior surface.
Fig. 22. Its upper articular end.
Fig. 23. Its lower articular end.
Fig. 24. The ulna and radius of the right side, fore and slightly outer view.
Fig. 25. Lower articular end of the same ulna.
Fig. 26. The metacarpal bones of the left wing, outer or exterior surface.

Fig. 27. Deep or flexor surface of the same bones.

Fig. 28. The anterior (thumb or radial) border of the metacarpus.

Fig. 29. Posterior or ulnar border of same.

Fig. 30. Upper or articular end of the left metacarpus, twice natural size.

Fig. 31. Its lower digital end, also enlarged to two diameters.

Fig. 32. The left femur, from behind.

Fig. 33. Right tibia (*t*) and fibula (*f*), their anterior surfaces.

Fig. 34. External or fibular side of the same tibia.

Fig. 35. Articular surface of its upper end.

Fig. 36. The lower articular extremity of the same.

Fig. 37. Tarso-metatarse of the left side, shown anteriorly.

Fig. 38. The inner or hallucial border of the same bone.

Fig. 39. The posterior aspect of the tarso-metatarse.

Fig. 40. Its superior articular extremity, magnified to two diameters.

Fig. 41. The inferior digital condyles of the tarsus, enlarged to twice the natural size.

PLATE XV.

Chiefly designed to show the characters of the feet, beak, and tongue-bones of different genera of the Motmots. All of exact natural proportions.

Fig. 42. Sole of the right foot of *Prionirhynchus carinatus*, with its cuticular covering &c.

Fig. 43. The bones of the right tarso-metatarse and foot of *Momotus* (*Baryphthengus*) *ruficapillus*. In this and fig. 42 the letters i, ii, iii, iv, respectively mark the great toe and successive digits.

Fig. 44. A segment of the base of the skull of *Momotus* (*Baryphthengus*) *ruficapillus*, to illustrate the presence of a small vomer (*vo*) lost or absent in the other forms examined: *m x p*, maxillo-palatine; *e p*, anterior ethmoidal process.

Fig. 45. A partial view of the upper or oral surface of the lower jaw of the preceding species of *Momotus*.

Fig. 46. Outside of the mandibular ramus of the same bird from the right.

Fig. 47. Tongue-bones or hyoidean arch of *M. ruficapillus*.

Fig. 48. The tongue-bones of *Eumomota superciliaris*.

In these two figures the individual osseous pieces are lettered as follows:—

g h, glosso-hyal; *b h*, basihyal; *u h*, uro-hyal; *c h*, cerato-hyal, and * its cartilaginous appendage; *t c*, tongue-cartilages.

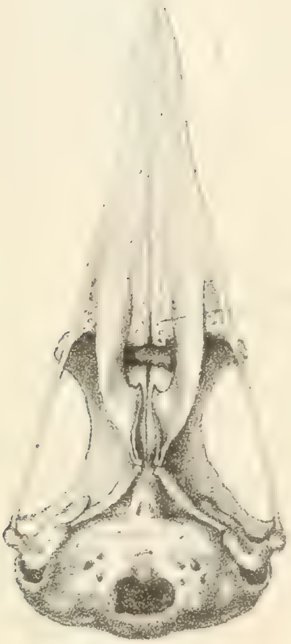
Fig. 49. Beak of *Momotus lessoni*, in side view and from above. Drawn from a specimen from Veragua.

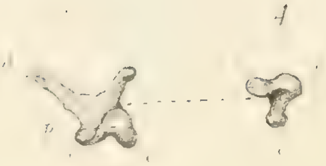
Fig. 50. Similar views of *Hylomanes momotula*. From Vera Paz.

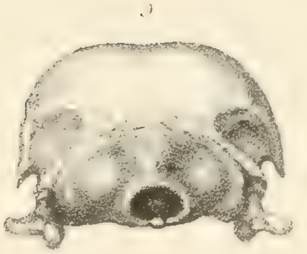
Fig. 51. Beak, laterally and superiorly, of *Eumomota superciliaris*. Specimen obtained at S. Pedro, Honduras.

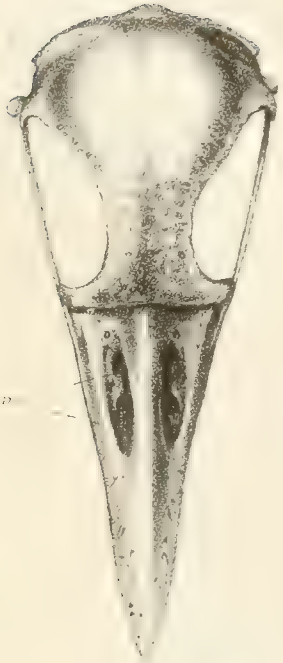
Fig. 52. Beak-surfaces of *Prionirhynchus carinatus*, from Guatemala.

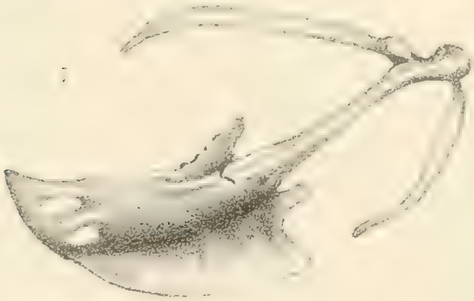
J Murie.

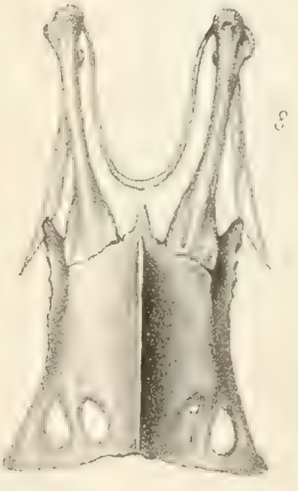


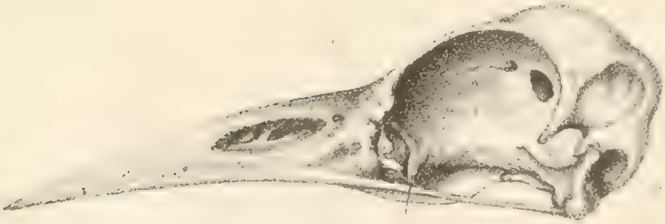


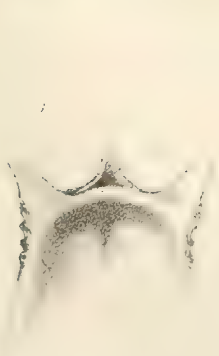


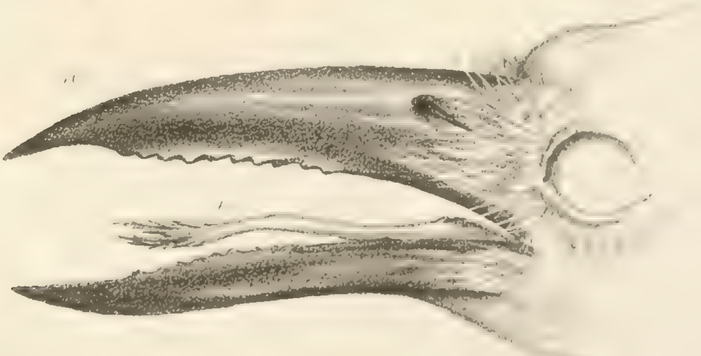












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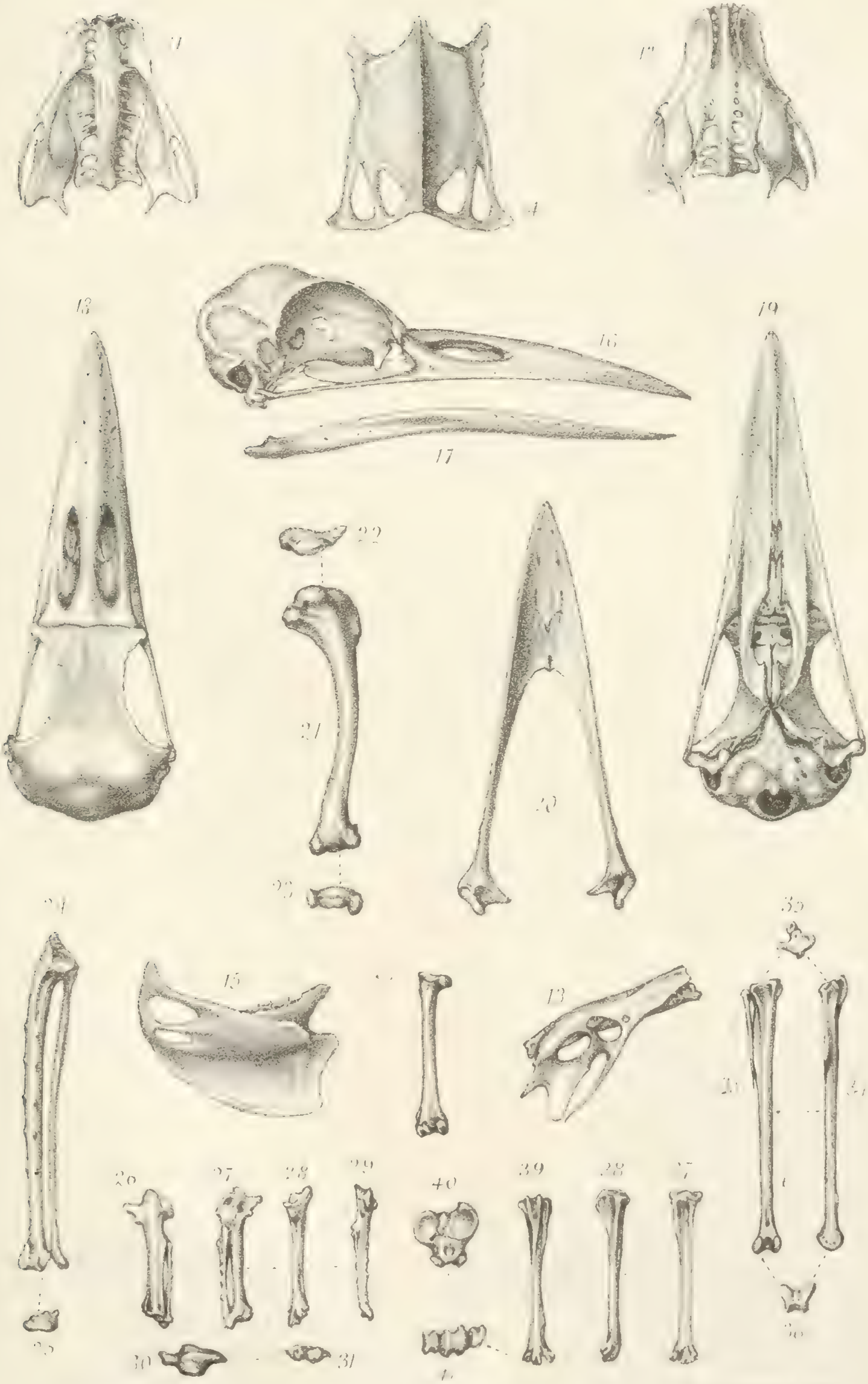
MOMOTUS LESSONI.



EUMOMOTA SUPERCILIARIS.

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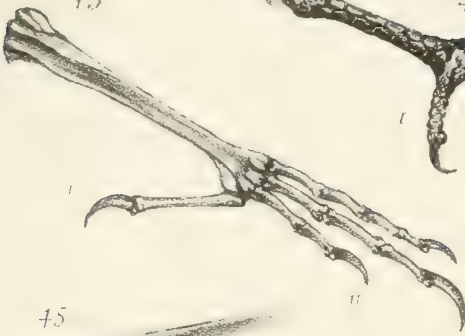

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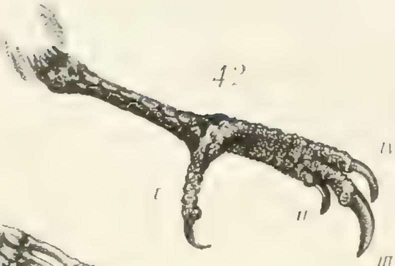

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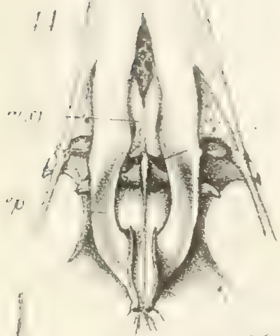

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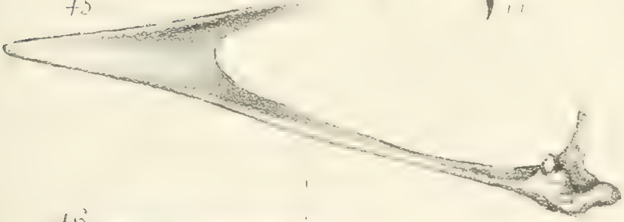

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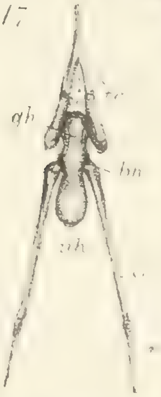

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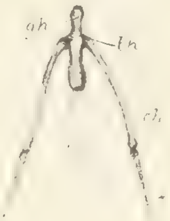

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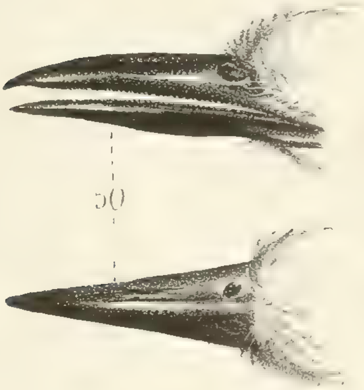

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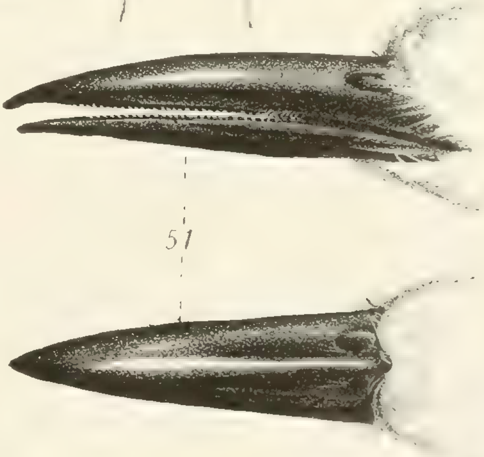

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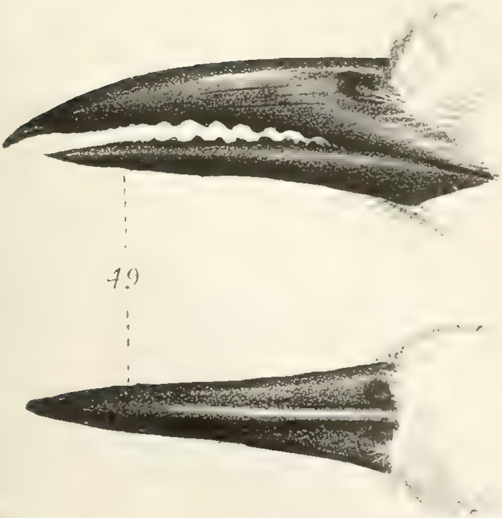

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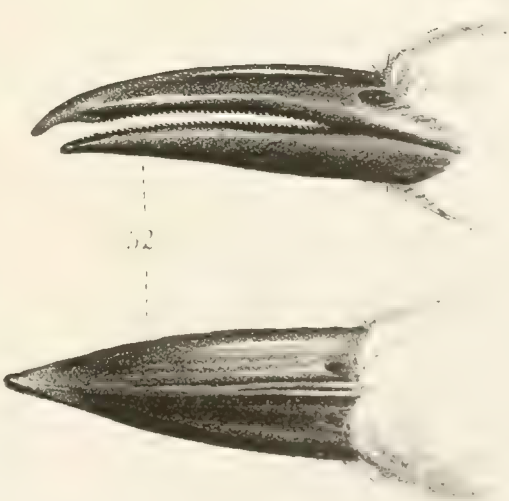

VARIOUS GENERA OF MOTMOTS